

# SITUATIONAL SELF-EFFICACY AND BEHAVIORAL RESPONSES TO WEARABLE USE

*Research in Progress*

Rieder, Annamina, University of St. Gallen, St. Gallen, Switzerland, annamina.rieder@unisg.ch

Rhyn, Marcel, University of St. Gallen, St. Gallen, Switzerland, marcel.rhyn@unisg.ch

## Abstract

*Wearables have the potential to optimize health-related behaviors like physical activity and nutritional intake and to improve individual health outcomes. However, researchers are still doubtful about wearables' capacity to induce behavior change in users. Research that has built on self-efficacy theory has shown that using wearables can influence the users' perceptions of self-efficacy and behavioral responses both positively and negatively, indicating that there is little stability over time. This study will investigate the factors that cause instability in users' situational perceptions of self-efficacy and behavioral reactions. We plan to conduct a longitudinal, quasi-experimental field study with wearable users who self-report in weekly intervals on action-related restrictiveness, contextual restrictiveness, personal restrictiveness, situational self-efficacy, and their behavioral responses over eight weeks. Preliminary results from a pilot study with a reduced sample showed promising results. We will contribute to self-efficacy research by clarifying the factors that cause variations in behavioral responses and finding quantitative support for a situationally varying construct of self-efficacy. We will contribute to practice by deriving implications for the design of wearable devices.*

*Keywords: wearable, health, self-efficacy, behavior change, longitudinal*

## 1 Introduction

Fifty-two percent of premature deaths worldwide are caused by such noncommunicable diseases as cardiovascular disease and diabetes, the causes of which can largely be traced back to physical inactivity (World Health Organization, 2010; 2014). Therefore, behavior change interventions that encourage physical activity and healthy nutrition are of key societal interest. Recent advances in mobile and sensor-based technologies have brought about an abundance of health interventions delivered through mobile and/or wearable technology. Wearables allow users to track their activities (e.g., daily steps, sports activity) and vital parameters (e.g., sleep patterns, heart rate) and to review these data using a digital interface to induce behavioral change (Wilson, 2013; Sjöklint et al., 2015). Despite wearables' potential, researchers are still doubtful about their capacity to change behavior—that is, to increase physical activity and decrease sedentary time (e.g., Slootmaker et al., 2009; West et al., 2016)—as well as the sustainability of intervention effects in the long term (Jakicic et al., 2016), which have been investigated in experimental studies (Brickwood et al., 2019). With an exploratory study looking into the processes through which the use of wearable features may lead to behavioral change applying a self-efficacy perspective (Rieder et al., 2019b), evidence on behavioral change in conjunction with wearable use is scarce in information systems (IS) research.

The self-efficacy theory, one of the dominant theories on behavioral change, provides a valuable lens through which to study behavioral change related to wearable use (Oinas-Kukkonen, 2013). Self-efficacy, which refers to an individual's perception of his or her ability to perform a particular behavior, is assumed to affect the initiation of, effort put toward, and the persistence with which individuals pursue an action (Bandura, 1977; 1982). In the wearable context, Rider et al. (2019b) suggested that wearables shape users' behavioral responses indirectly through the influencing factors on users' self-efficacy and, based on the hampering effect of these influencing factors, that users' perceptions of their self-efficacy may vary situationally, indicating the instability of the self-efficacy construct influenced by wearable use. Since Rieder et al.'s (2019b) research is exploratory in nature, it does not specify the influencing factors or the instability of the self-efficacy construct. However, understanding these aspects of wearable use and the related self-efficacy is necessary to explain wearable technology's behavioral effects and to improving the technology's design and the health interventions in which they are employed. Therefore, the research question asks: *How do situational factors restrict users' perceptions of self-efficacy and behavioral responses to wearable use?*

To address this research question, we will conduct an eight-week, longitudinal, quasi-experimental field study with 150 long-term wearable users who self-report weekly about the circumstances, their situational perceptions of self-efficacy, and behavioral responses related to their most recent occasion of wearable use. Thus, we expect to show the nature of variations in wearable users' situational perceptions of self-efficacy and to shed light on the factors that restrict the situational perceptions of self-efficacy and cause the variations. The research will contribute to research on wearables by explaining why wearable use has a situationally varying effect on perceptions of self-efficacy and behavioral responses that depend on a set of restricting factors. Moreover, by underscoring the situational instability of perceptions of self-efficacy related to wearable use, we demonstrate the theoretical importance of a situationally variable conceptualization of self-efficacy, thereby extending the body of self-efficacy literature. Our findings will also have implications for the design of wearable devices.

The remainder of this paper is structured as follows: Section 2 outlines the theoretical background of our research, including wearables and self-efficacy theory. In section 3, we derive our research model and hypotheses, while section 4 gives an overview of our proposed research method. Section 5 presents the results of our pilot study, and section 6 concludes with an outlook on the expected contributions of our research and important next steps.

## 2 Theoretical Background

### 2.1 Wearables for Behavior Change

Wearables are sensor-equipped devices worn on the body and encompass a wide range of devices (e.g., wristbands, glasses, clothing) (Wilson et al., 2013; Sjöklint et al., 2015). Our study focuses on the most prominent category, that is, wearable devices that allow users to track their activities (e.g., daily steps, sports activity) and vital parameters (e.g., sleep patterns, heart rate) using a digital interface either directly on the device's screen or via a smartphone or computer. Positioned as facilitators of changes in health-related behavior, wearables typically use a variety of persuasive techniques (Lyons et al., 2014; Mercer et al., 2016), such as encouraging users to reach a daily step goal and keeping them current regarding their progress. Users who track their nutrition may also decide to cut their caloric intake based on the data the wearable provides.

A large body of literature in medical and nutritional sciences has addressed the effectiveness of wearables in health-related interventions (see Brickwood et al. (2019) for a meta-analysis.). Many studies have been optimistic about wearables' effectiveness in improving health-related outcomes; in particular, experimental studies have found positive effects of wearable use on daily steps and energy expenditure. However, other health-related parameters, such as sedentary time and sports activity, have been found to be unaffected by wearable use. A study using wearables in weight-loss interventions found the effect to be inferior to that of standard behavioral interventions and questioned

the long-term effectiveness of wearable-related interventions, as effects on body weight were not sustained over the 24-month study period (Jakicic et al., 2016). In short, findings on the effectiveness of wearables in health interventions are mixed.

Studies in IS research on wearables have adopted a more fine-grained perspective and examined, for example, the acceptance (e.g., Lunney et al., 2016) and use (e.g., Becker et al., 2017; Rieder et al., 2019a) of wearables or information-privacy concerns (e.g., Wieneke et al., 2016). Some of these studies have offered first insights into post-adoptive use behaviors and wearable-induced behavioral changes. Rieder et al. (2019b), one of the few IS studies on behavior change, applied the self-efficacy theory to explore how wearables drive behavioral change, finding that wearables may shape behavior either positively or negatively indirectly through evaluations of the context and beliefs related to self-efficacy. They identified such restricting factors as work schedules, injuries, and climatic conditions that are assumed to determine the direction of users' perceptions of self-efficacy and behavioral responses. Given the suspicion that these restricting factors cause the situational variation in wearable users' self-efficacy and behavioral responses, clarifying the factors that play a role in improving wearables and related interventions is essential.

## 2.2 Self-Efficacy and Restricting Factors

Originating from cognitive psychology, Bandura's (1977) self-efficacy theory is one of the dominant behavior-change theories. It has been transferred to various disciplines, including education, nutritional science, psychotherapy, management science, and IS. At its core lies the assumption that a *behavior* is strongly affected by individuals' beliefs about their own capacity to perform that behavior; since self-efficacy refers to individuals' perceptions of their own *efficacy*, it is frequently referred to as "perceived self-efficacy" (Bandura, 1997). To form beliefs or *perceptions* of self-efficacy, individuals draw on information like feedback, circumstances, patterns of action, and consequences, which they synthesize over long periods of time. Self-efficacy is an important precursor of behavior and behavioral change because it affects individuals' readiness to initiate a behavior and the effort and persistence required to pursue it despite obstacles (Bandura, 1977, 1982; Stajkovic and Luthans, 1998).

IS researchers have applied the self-efficacy theory for more than thirty years, predominantly studying how using IS may influence self-efficacy and its role in IS acceptance. (See Rieder et al., 2019b for a comprehensive literature review.) Several IS studies have found that IS with behavioral outcomes, such as wearables, positively influence users' perceived self-efficacy (e.g., Kuonanoja et al., 2015). Rieder et al. (2019b) also described a negative path from wearable use to low self-efficacy to withstanding behavioral change. Moreover, self-efficacy is regarded as a key determining factor in IS acceptance (e.g., Pavlou and Fygenson, 2006) and in other behaviors related to IS, such as users' coping behaviors related to threats from information technology (Liang and Xue, 2009).

Bandura (1977, 1982) suggested that perceptions of self-efficacy may be restricted by several kinds of factors. First, action-related factors, which particularly encompass a task's difficulty level (Bandura, 1977), including that related to wearables (Rieder et al., 2019b), may hamper individuals' self-efficacy. Studies on barriers to self-efficacy related to physical exercise incorporate the activity's affordability and enjoyability as potentially restricting (Blanchard et al., 2002). Second, restricting factors, which relate to the external and social circumstances in which an action is undertaken (Bandura, 1977), may arise from the situation or the context. Findings from wearable research have supported the restrictive effect of external factors but have not further specified them (Rieder et al., 2019b). Health education research has suggested that a restrictive context is one in which it is impossible to engage in an activity because of other priorities or stressful life changes and external factors like the weather (Sallis et al., 1988). A qualitative study conducted in the context of breast cancer screening indicated the influence of sociocultural factors like social capital, social support, and one's economic condition on women's perceived self-efficacy (Burke et al., 2010). Studies related to diabetes self-management revealed a wide range of barriers, including financial strain, the lack of social support, environmental influences (e.g., climate), and work-related issues (i.e., schedules and

traveling) (Adu et al., 2019; Muchiri et al., 2019). Third, personal factors like the effort required, attribution, and coping capabilities may have an attenuating effect on self-efficacy (Bandura, 1982; Stajkovic and Luthans, 1998). Studies on exercise-related self-efficacy specify personal factors like health issues, the tendency to succumb to temptation, and negative emotions related to an activity (Blanchard et al., 2002; Blanchard et al., 2007; Sallis et al., 1988). In the academic context, the personality traits of conscientiousness and neuroticism have been found to influence students' self-efficacy, mediated by self-management skills and perception of situational constraints (Gerhardt et al., 2007). Other studies related to physical activity have found instantiations of all three categories of barriers that influence participants' self-efficacy and engagement in leisure-time physical activity (Cramp and Bray, 2011; Hayotte et al. 2020).

In line with other research on the constraints to self-efficacy, Rieder et al. (2019b) found that wearable users' perceptions of self-efficacy and their subsequent behavioral responses are volatile, based on the presence or absence of restricting factors. The study corroborates that the use of wearable features, together with a set of restricting factors in the environment and related to the action, shapes users' perceptions of self-efficacy related to the behavior the wearable prescribes. Depending on the momentary restrictions these factors impose, the self-efficacy perceptions may be high or low, leading to behavioral responses that differ based on the situation (i.e., performance (non-performance) based on high (low) self-efficacy). This corroboration contrasts with the assumed generalizability of individuals' perceptions of self-efficacy. The construct of general self-efficacy (cf. Chen et al., 2001) refers to the most generalizable form of self-efficacy, which assumes that all previous efficacy-related experience adds up to an overall self-efficacy, although Bandura's (1977, 1997) task-specific self-efficacy construct assumes generalizability only for tasks in the same or closely related domains and does not account for the situational changes in the construct that have been observed with wearable use. Hence, we argue that quantitative investigation of situational self-efficacy and the factors that cause the situational variation is central to our ability to explain self-efficacy in general and self-efficacy related to wearable use and health-related behaviors.

### 3 Research Model and Hypotheses

Drawing on this theoretical background, we developed the research model shown in Figure 1.

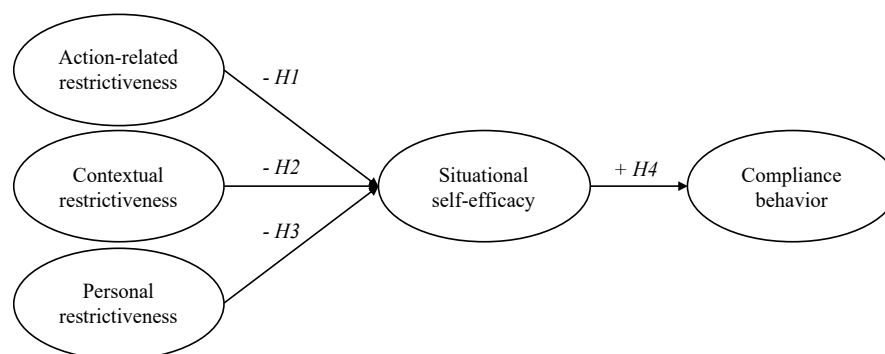


Figure 1. Research Model

When forming self-efficacy perceptions regarding whether to comply with a technology cue or not, wearable users not only rely on the traditional sources of self-efficacy (e.g., personal or vicarious mastery experiences, verbal persuasion; cf. Bandura 1977) but also take into account a variety of factors that might restrict their confidence in their ability to comply. Evidence has suggested that restricting influences may originate from three spheres: the action, the context, and the individual, where *action-related restrictiveness* impairs self-efficacy if the action or task is perceived as too difficult, not affordable, or not enjoyable (cf. Blanchard et al., 2002; Rieder et al. 2019b); *contextual restrictiveness* hampers self-efficacy if the behavior is requested in a situation in which users feel

unable to comply because of work- or family-related duties, stressful life changes, or environmental factors (e.g., the weather) (cf. Adu et al., 2019; Muchiri et al., 2019; Sallis et al., 1988); and *personal restrictiveness* has a limiting effect on self-efficacy when health issues, strong negative emotions (e.g., anxiety), or the inability to resist temptation are present (cf. Blanchard et al., 2002, 2007; Sallis et al., 1988; Stajkovic and Luthans, 1998). Building on Bandura's original tripartition, we hypothesize wearable users' situational self-efficacy to be attenuated by three the same three constructs:

*H1: Action-related restrictiveness has a negative effect on situational self-efficacy.*

*H2: Contextual restrictiveness has a negative effect on situational self-efficacy.*

*H3: Personal restrictiveness has a negative effect on situational self-efficacy.*

The link between self-efficacy and behavior has been investigated and verified by multiple studies (e.g., Bandura, 1977, 1982; Linde et al., 2006; Strecher et al., 1986). What is new about the relationship proposed in our research model is that our three restrictiveness-related constructs introduce situational variation to the model, such that self-efficacy and compliance behavior vary depending on the situation. This approach is in accordance with Rieder et al. (2019b), which highlights the situational changes in self-efficacy perceptions and reactions to wearable use. We argue that information from attenuating factors is incorporated into an individual's situational (rather than time-invariant) perception of self-efficacy, which then have a direct influence on wearable users' (non-)compliance behavior. Compliance behavior refers to the adherence to the wearable's request (cf. Oinas-Kukkonen, 2013). Despite being a momentary reaction to a technology cue, compliance is an important precursor of higher-level behavioral changes in, for example, habits, routines, or attitudes (ibid.). By becoming routinized and ingrained in users' behavioral patterns, compliance reactions may lead to sustained change in habits, which is needed to leverage the full behavior-changing potential of the technology (Rieder et al., 2019a). With regard to the proposed model's situational focus, we hypothesize:

*H4: The higher an individual's situational self-efficacy, the more likely he or she will show compliance behavior.*

## 4 Method

We will conduct a longitudinal quasi-experimental field study to address our research question. The aim of our study is to determine the effect of situational attenuating factors on situational self-efficacy, and an experimental design is an appropriate means to substantiate the proposed causal relationships. In addition, most of our hypotheses' boundedness in the specificities of the use context requires us to study users in their natural setting, making a field study suitable. What's more, given the process-related nature of our research model, a longitudinal design is required to test our hypotheses.

Our study relies on wearable users as participants who self-report weekly on multiple measures regarding their wearable use for eight weeks. Since we consider a natural setting necessary to the research's plausibility and feasibility, we cannot design and manipulate a stimulus object, so random picks are not possible. Therefore, to verify our hypotheses, we use participants' self-reported measures with regard to the presence of restrictiveness and the magnitude of situational self-efficacy to assign the participants to experimental groups. Thus, our study is a quasi-experiment.

### 4.1 Data Collection

We plan to conduct our experiment with 150 long-term users of Fitbit wearable devices based in Switzerland. With a market penetration of 7.8 percent in 2019, Switzerland is one of the most advanced wearable markets in Europe (Statista, 2019). A snowball sampling strategy will be applied (Goodman, 1961), and additional participants will be recruited using ads on social network sites. The primary inclusion criterion is a minimum of six months use of the wearable, a period sufficient for users to move past the adoption and trial phases and show continuous use behavior (Rieder et al., 2019a). Among the users who meet this criterion, we seek maximum variance in demographics and use cases. We limit our sample to Fitbit users to provide some control of the feature sets and

affordances the devices provide. Moreover, Fitbit, which focuses exclusively on self-tracking devices, holds the second-largest market share in the European wearable market, exceeded only by Apple (Statista, 2020), which offers smart watches with a more advanced set of features besides those self-tracking. A sample size of 150 participants is appropriate, recognized standards cite sample sizes of 100 to 150 as sufficient for structural equation modelling, which we will use for our longitudinal mediation analysis (Wolf et al., 2013).

For the experiment's technical implementation, we will use Unipark by Questback, a surveying tool designed for academic purposes. The participants will receive basic, non-deceptive instruction on the purpose of the study (i.e., studying user behavior with wearables) but not on the specific hypotheses to avoid bias (Webster and Sell, 2014). At time  $t_0$ , a base survey will be sent out that asks for the participants' demographics and information on the time-invariant control variables (i.e., primary use purpose, user goals, habits, general self-efficacy, readiness to change, locus of causality, personality traits). Also at  $t_0$ , the participants will receive the first recurring survey, encompassing questions regarding the features used and the time-varying variables (i.e., restrictiveness of circumstances, situational self-efficacy, and compliance behavior). To prime the participants to think about the situation thoroughly, open questions will ask them to describe their most recent usage, covering the feature they used, the use purpose, and how they used it. The remainder of the survey will ask the participants to relate their situational self-efficacy, the restrictiveness of the circumstances, and their behavioral response to the use situation they described.

The participants will be required to take the survey immediately after receiving it—at the end of the day at the latest—to ensure equal time periods between the surveys across participants. The recurring survey will be sent out every six days so the weekdays on which participants receive them alternate, allowing us to control for possible differences across weekdays. The recurring survey will be repeated seven times after its initial distribution at  $t_0$  ( $t_1$  to  $t_7$ ). This time span is sufficient to capture multiple instances of variability in situational self-efficacy and behavioral responses and because most seasonal effects (e.g., New Year's resolutions) will not outlast the period. At the same time, an eight-week study horizon seemed to be short enough to minimize dropouts.

## 4.2 Measures

The measures presented below are only an excerpt of the measures to be used in the study, as are the detailed questionnaires provided in the appendix. Because of space limitations, we focus here on the most central scales on restrictiveness, situational self-efficacy, and compliance behavior.

**Restrictiveness:** To measure the restrictiveness constructs related to the action, the context, and the individual, as originally proposed by Bandura (1977, 1982), we will draw on factors identified and items used by related literature (Blanchard et al., 2002, 2007; Sallis et al., 1988). The items proposed can be found in the appendix. The participants will be asked to relate to a specific instance of wearable use when responding to the items (using a five-point Likert-scale), which will allow us to compute an average value of restrictiveness for each construct.

**Situational Self-Efficacy:** Since we lack a specific and situationally variable construct of self-efficacy, we developed a three-item scale for its measurement. We identified three manifestations of self-efficacy that are relevant to our research: 1) task self-efficacy, which refers to a person's confidence in his or her ability to engage in a specific task (cf. Blanchard et al., 2007; Sweet et al., 2012); 2) relapse self-efficacy, marking one's confidence in one's ability to resist relapse (cf. Sallis et al., 1988); and 3) scheduling self-efficacy, representing one's confidence in the ability to plan and make time to engage in a specific task (cf. Maddison and Prapavessis, 2016; Sallis et al., 1988; Scholz et al., 2016). The items proposed can be found in the appendix. The participants will be asked to relate to a specific instance of wearable use when responding to the items (using a five-point Likert-scale, which will allow us to average situational self-efficacy).

**Compliance Behavior:** In contrast to similar constructs, such as behavior or attitude change, that are not momentarily observable but can be observed only over time (Oinas-Kukkonen, 2013), we address "snapshots" of specific use situations, so the behavioral outcomes may be only two-dimensional,

marking either a compliant or non-compliant behavioral reaction with the wearable request. Compliance behavior will be determined by asking whether the participants did or did not change their behavior in the situation.

## 5 Preliminary Results

We conducted a pilot study to test the validity of our scales (especially situational self-efficacy) and to determine whether the study participants would accept and follow the procedure. The pilot study covered the full time period but used a limited sample of ten participants. Meaningful results in diary studies can be achieved even with samples as small as seven participants (Teuchmann et al., 1999). Keeping our criterion of a minimum use duration of six months, we relied on an ad-hoc sample, although we tried to reach some variation in age, gender, and profession. Our sample consisted of two women and eight men, all aged between 23 to 69 years ( $M=37.3$ ). The devices used by most participants were by Garmin, Fitbit, and Samsung. Because of the limited sample size, we did not use a full-fledged structural equation model (SEM) with action-related, contextual, and personal restrictiveness but tested the overall effect of the factors that restrict situational self-efficacy (H1-H3) and the effect of situational self-efficacy on compliance behavior (H4). For panel data with repeated measures for each individual, it is important to account for potential random or fixed effects. In our case, the Hausman (1978) test indicates that random-effects models are preferred over fixed-effects models, so we used a random-effects panel linear regression model to test the effect of the restricting factors on situational self-efficacy (Table 1) and a panel logit model to test the effect of situational self-efficacy on compliance behavior (Table 2).

	<i>Coefficient</i>	<i>Std. Error</i>	<i>z-Value</i>
Intercept	-5.071	1.496	-3.389 ***
RF	-0.417	0.173	-2.408 *
Control: GSE	2.169	0.346	6.278 ***
Adj. R-Sq.	0.392		
Chi-Sq.	43.11 *** (df = 2)		
N <sup>a</sup>	70		

Note: <sup>a</sup> 10 participants; \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ ; RF = Restricting Factors; GSE = General Self-Efficacy

Table 1. *Effect of the Restricting Factors on Situational Self-Efficacy*

	<i>Coefficient</i>	<i>Std. Error</i>	<i>z-Value</i>
Intercept	-3.247	1.931	-1.682
SSE	1.192	0.481	2.476 **
AIC	72.59		
Residual dev.	66.59 (df = 67)		
N <sup>a</sup>	70		

Note: <sup>a</sup> 10 participants; \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ ; SSE = Situational Self-Efficacy

Table 2. *Effect of Situational Self-Efficacy on Compliance Behavior*

The preliminary results indicate support for our hypotheses, suggesting that, overall, the restricting factors have a negative effect on situational self-efficacy ( $\beta = -0.417$ ;  $p = 0.016$ ) and that situational self-efficacy has a positive effect on compliance behavior ( $\beta = 1.192$ ;  $p = 0.013$ ). The model fit is good (Adj.  $R^2 = 0.392$ ). With regard to the situational self-efficacy construct's internal validity, the Cronbach's alpha yields a value of 0.91, which can be considered excellent (Nunnally, 1978). The promising results of the pilot study have important implications for our future work, as they provide evidence that compliance behavior is affected by a *situational* form of self-efficacy and that situational self-efficacy is influenced by restricting factors. To examine in more detail the effects of action-

related, contextual, and personal restrictiveness on situational self-efficacy, further investigation with a more comprehensive experiment is warranted.

## 6 Expected Contribution and Next Steps

Our findings will contribute to research and practice. They will contribute to self-efficacy research by demonstrating the instability of self-efficacy perceptions in the wearable context, thereby highlighting the importance of a specific and situationally variable self-efficacy construct that complements the established understanding of generalized and stable self-efficacy perceptions. Our research will also clarify the behavioral change processes that are associated with wearable use and the factors that may restrict behavioral change, thus offering an explanation for the conflicting study results regarding wearables' effectiveness and allowing us to predict under what circumstances behavioral change is likely or less likely to occur. In addition, our study will have implications for wearable providers and intervention designers, as identifying the factors that restrict users' compliance with wearables' cues will help to address concrete barriers and obstacles. The volatility of self-efficacy perceptions also indicates the importance of repeatedly persuading of users of their ability to perform a behavior.

Our next steps include recruiting the 150 participants and conducting the experiment in cohorts during summer 2020. After that, we will analyze the data and test our hypotheses.

## Appendix

**Questionnaire for situational self-efficacy** (*five-point Likert scale, strongly disagree to strongly agree*):

In the above situation, I was confident in my ability to:

- 1) Enable myself to do the behavior (e.g., make time for the behavior) (*scheduling self-efficacy*)
- 2) Engage in the behavior as needed for my goals (e.g., do the behavior) (*task self-efficacy*)
- 3) Stick to my behavior goals when facing difficulties or obstacles (e.g., not give up on the behavior) (*relapse self-efficacy*)

**Questionnaire for restrictiveness of circumstances** (*five-point Likert scale, strongly disagree to strongly agree*):

Did you encounter any negative circumstances or obstacles in your situation?

- 1) I had other work-related priorities (e.g., I had an important deadline coming up) (*contextual*)
- 2) I do not enjoy the activity (e.g., I do not enjoy running) (*action-related*)
- 3) It was impossible for me to do the activity because of the context (e.g., I could not run outside because there was a thunderstorm) (*contextual*)
- 4) I felt strong negative emotions (e.g., I was afraid of running in the dark) (*personal*)
- 5) The activity was too difficult (e.g., I cannot run 20km) (*action-related*)
- 6) I am going through a stressful personal life change (e.g., I recently lost a close family member) (*contextual*)
- 7) The temptation not to engage in the activity/behavior were too high (e.g., I was invited to dinner and could not resist the unhealthy food served) (*personal*)
- 8) My health did not allow me to do the activity (e.g., I had a 40° fever) (*personal*)
- 9) I did not have the funds to do the activity (e.g., I could not afford the green fee) (*action-related*)
- 10) I had other priorities related to family and friends (e.g., my son was sick) (*contextual*)
- 11) None
- 12) Other (please specify) [*with text field*]

**Questionnaire for compliance behavior** (*multiple choice*):

Following the situation in which you used your wearable, how did you react?

- I did not change my behavior.
- I adjusted my behavior to what the wearable intended.



## References

- Adu, M.D., Malabu, U.H., Malau-Aduli, A.E.O., Malau-Aduli, B.S. (2019). "Enablers and Barriers to Effective Diabetes Self-Management: A Multinational Investigation." *PLoS ONE* 14 (6), 1–22.
- Bandura, A. (1977). "Self-Efficacy: Toward A Unifying Theory of Behavioral Change." *Psychological Review* 84, 191–215.
- Bandura, A. (1982). "Self-Efficacy Mechanism in Human Agency." *American Psychologist* 37 (2), 122–147.
- Bandura, A. (1997). *Self-Efficacy. The Exercise of Control*. New York: W.H. Freeman and Company.
- Becker, M., Kolbeck, A., Matt, C., and Hess, T. (2017). "Understanding the Continuous Use of Fitness Trackers: A Thematic Analysis". In: *PACIS 2017 Proceedings*.
- Blanchard, C. M., Rodgers, W. M., Courneya, K. S., Daub, B., & Knapik, G. (2002). "Does barrier efficacy mediate the gender-exercise adherence relationship during phase II cardiac rehabilitation?" *Rehabilitation Psychology*, 47(1), 106–120.
- Blanchard, C. M., Fortier, M., Sweet, S., O'Sullivan, T., Hogg, W., Reid, R. D., & Sigal, R. J. (2007). "Explaining physical activity levels from a self-efficacy perspective: The physical activity counseling trial." *Annals of Behavioral Medicine*, 34(3), 323–328.
- Brickwood, K.-J., Watson, G., O'Brien, J., and Williams, A.D. (2019). "Consumer-Based Wearable Activity Trackers Increase Physical Activity Participation: Systematic Review and Meta-Analysis." *JMIR Mhealth Uhealth* 7 (4), 1-20.
- Burke, N.J., Bird, J.A., Clark, M.A., Rakowski, W., Guerra, C., Barker, J.C., and Pasick, R.J. (2010). "Social and Cultural Meanings of Self-Efficacy." *Health Education and Behavior* 36 (5), 111–128.
- Chen, G., Gully, S.M., and Eden, D. (2001). "Validation of a New General Self-Efficacy Scale." *Organizational Research Methods* 4, 62–83.
- Cramp, A.G., and Bray, S.R. (2011). "Understanding Exercise Self-Efficacy and Barriers to Leisure-Time Physical Activity Among Postnatal Women." *Maternal and Child Health Journal* 15, 642–651.
- Goodman, L.A. (1961). "Snowball Sampling." *The Annals of Mathematical Statistics* 32 (1), 148–170.
- Gerhardt, M.W., Rode, J.C., Peterson, S.J. (2007). "Exploring Mechanisms in the personality–Performance Relationship: Mediating Roles of Self-Management and Situational Constraints." *Personality and Individual Differences* 43, 1344–1355.
- Hausman, J. A. (1978). "Specification Tests in Econometrics," *Econometrica* 46 (6), 1251–1271.
- Hayotte, M., Nègre, V., Gray, L., Sadoul, J.L., and d'Arripe-Longueville, F. (2020). "The Transtheoretical Model (TTM) to Gain Insight into Young Women's Long-Term Physical Activity after Bariatric Surgery: A Qualitative Study." *Obesity Surgery* 30, 595–602.
- Jakicic, J.M., Davis, K.K., Rogers, R.J., King, W.C., Marcus, M.D., Helsel, D., ..., Belle, S.H. (2016). "Effect of Wearable Technology Combined With a Lifestyle Intervention on Long-term Weight Loss: The IDEA Randomized Clinical Trial." *Journal of the American Medical Association* 316 (11), 1161-1171.
- Kuonanoja, L., Langrial, S., Lappalainen, R., Lappalainen, P., and Oinas-Kukkonen, H. (2015). "Treating Depression with a Behavior Change Support System without Face-to-Face Therapy." *Transactions on Human Computer Interaction* 7 (3), 192–210.
- Liang, H. and Xue, Y. (2009). "Avoidance of Information Technology Threats: A Theoretical Perspective." *Management Information Systems Quarterly* 33 (1), 71–90.
- Linde, J.A., Rothman, A.J., Baldwin, A.S., and Jeffery, R.W. (2006). "The Impact of Self-Efficacy on Behavior Change and Weight Change Among Overweight Participants in a Weight Loss Trial." *Health Psychology* 25 (3) 282–291.
- Lunney, A., Cunningham, N.R., and Eastin, M.S. (2016). "Wearable fitness technology: A structural investigation into acceptance and perceived fitness outcomes." *Computers in Human Behavior* 65, 114–120.
- Lyons E.J., Lewis Z.H., Mayrsohn B.G., and Rowland J.L. (2014). "Behavior Change Techniques Implemented in Electronic Lifestyle Activity Monitors: A Systematic Content Analysis." *Journal of Medical Internet Research* 16 (8), 1-15.

- Maddison, R., and Prapavessis, H. (2016). "Using Self-Efficacy and Intention to Predict Exercise Compliance among Patients with Ischemic Heart Disease." *Journal of Sport and Exercise Psychology* 26 (4), 511–524.
- Mercer, K., Li, M., Giangregorio, L., Burns, C., and Grindrod, K. (2016). "Behavior Change Techniques Present in Wearable Activity Trackers: A Critical Analysis." *JMIR mHealth uHealth* 4 (2), 1-9.
- Muchiri, J.W., Gericke, G.J., and Rheeder, P. (2019). "Stakeholders' Perceptions of Dietary and Related Self-Management Challenges and Education Programme Preferences for Type 2 Diabetes Adults." *Journal of Endocrinology* 24 (1), 1–9.
- Nunnally, J.C. (1978). *Psychometric theory*. 2nd Edition, McGraw-Hill, New York.
- Oinas-Kukkonen, H. (2013). "A Foundation for the Study of Behavior Change Support Systems." *Personal and Ubiquitous Computing* 17, 1223–1235.
- Pavlou, P.A. and Fygenon, M. (2006). "Understanding and Predicting Electronic Commerce Adoption: An Extension of the Theory of Planned Behavior." *Management Information Systems Quarterly* 30 (1), 115–143.
- Rieder, A., Lehrer, C., and Jung, R. (2019a). "Understanding the Habitual Use of Wearable Activity Trackers." In: *14th International Conference on Wirtschaftsinformatik, Siegen*, pp. 1002–1016.
- Rieder, A., Lehrer, C., and Jung, R. (2019b). "How Behavior Change Support Systems Influence Self-Efficacy: A Qualitative Study Using Wearables." In: *Proceedings of the 27th European Conference on Information Systems (ECIS2019), Stockholm-Uppsala, Sweden*.
- Sallis, J. F., Pinski, R. B., Grossman, R. M., Patterson, T. L., & Nader, P. R. (1988). "The development of self-efficacy scales for health-related diet and exercise behaviors." *Health Education Research* 3 (3), 283–292.
- Scholz, U., Sniehotta, F. F., & Schwarzer, R. (2016). "Predicting Physical Exercise in Cardiac Rehabilitation: The Role of Phase-Specific Self-Efficacy Beliefs." *Journal of Sport and Exercise Psychology* 27 (2), 135–151.
- Sjöklint, M., Constantiou, I., and Trier, M. (2015). "The Complexities of Self-Tracking - An Inquiry into User Reactions and Goal Attainment," In: *Proceedings of the 23rd European Conference on Information Systems*.
- Slootmaker, S.A., Chinapaw, M.J.M., Schuit, A.J., Seidell, J.C., and van Mechelen, W. (2009). "Feasibility and Effectiveness of Online Physical Activity Advice Based on a Personal Activity Monitor: Randomized Controlled Trial," *Journal of Medical Internet Research* 11 (3).
- Stajkovic, A.D. and Luthans, F. (1998). "Self-Efficacy and Work-Related Performance: A Meta-Analysis." *Psychological Bulletin* 124 (2), 240–261.
- Statista (2019). *Wearables*. URL: <https://de.statista.com/outlook/319/155/wearables/schweiz> (visited on 18/11/2019).
- Statista (2020). *Europe: Market Share of the Leading Five Wearable Device Companies in Q2 2018 and Q2 2019*. URL: <https://www.statista.com/statistics/1064898/europe-wearable-device-market/> (visited on 19/03/2020)
- Strecher, V.J., McEvoy DeVellis, B., Becker, M.H., and Rosenstock, I.M. (1986). "The Role of Self-Efficacy in Achieving Health Behavior Change." *Health Education Quarterly* 13 (1), 73–91.
- Sweet, S. N., Fortier, M. S., Strachan, S. M., & Blanchard, C. M. (2012). "Testing and integrating self-determination theory and self-efficacy theory in a physical activity context." *Canadian Psychology* 53 (4), 319–327.
- Teuchmann, K., Totterdell, P., & Parker, S. (1999). "Rushed, unhappy, and drained: An experience sampling study of relations between time pressure, perceived control, mood, and emotional exhaustion in a group of accountants." *Journal of Occupational Health Psychology* 4 (1), 37–54.
- Webster, M., & Sell, J. (2014). *Laboratory Experiments in the Social Sciences, 2<sup>nd</sup> Edition*. Amsterdam, The Netherlands: Academic Press.
- West, D.S., Monroe, C.M., Turner-McGrievy, G., Sundstorm, B., Larsen, C., Magradey, K., Wilcox, S., and Brandt, H.M. (2016). "A Technology-Mediated Behavioral Weight Gain Prevention Intervention for College Students: Controlled, Quasi-Experimental Study." *Journal of Medical Internet Research* 18 (6), 1-13.

- Wieneke, A., Lehrer, C., Zeder, R., and Jung, R. (2016). "Privacy-related decision-making in the context of wearable use." In: *Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS) 2016*. Chiayi, Taiwan.
- Wilson, H.J. (2013). "Wearables in the Workplace." *Harvard Business Review* 91(11), 23–25.
- Wolf, E.J., Harrington, K.M., Clark, S.L., and Miller, M.W. (2013). "Sample Size Requirements for Structural Equation Models: An Evaluation of Power, Bias, and Solution Propriety." *Educational and Psychological Measurement* 76 (6), 913–934.
- World Health Organization 2010. *Global Recommendations on Physical Activity for Health*, Geneva, Switzerland: WHO Press.
- World Health Organization 2014. *Global Status Report on Noncommunicable Diseases*, Geneva, Switzerland: WHO Press.